REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
04/09/2018	Master's Thesis	July 2017 - April 2018

4. TITLE AND SUBTITLE
The Modern Space Domain: On the Eve of Weaponization?

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
Lt Col Mark Hauser

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Joint Forces Staff College
Joint Advanced Warfighting School
7800 Hampton Blvd
Norfolk, VA 23511

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES
None

14. ABSTRACT
Over the past 60 years, the world, and most decisively the US, harnessed space-enabled effects for both military and civil purposes. The lack of comprehensive international agreements restricting non-WMD offensive space-based capabilities and the asymmetric advantages space capabilities provide the US military represent an opportunity and incentive for potential competitors to weaponize space. This thesis examines the evolution of the space domain and provides recommendations for the future US space posture through three lenses: redesigning a space strategy based on deterrence, reviewing the organizational structure, and completing a space-based capability review that avoids a security dilemma in space.

15. SUBJECT TERMS
Space Warfighting Domain; Weaponization of Space; Space history

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Mark A. Hauser
UNCLAS	UNCLAS	UNCLAS	UNCLAS; Unlimited	59	19b. TELEPHONE NUMBER *(Include area code)* 618-795-3900

NATIONAL DEFENSE UNIVERSITY

JOINT FORCES STAFF COLLEGE

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THE MODERN SPACE DOMAIN: ON THE EVE OF WEAPONIZATION?

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THE MODERN SPACE DOMAIN: ON THE EVE OF WEAPONIZATION?

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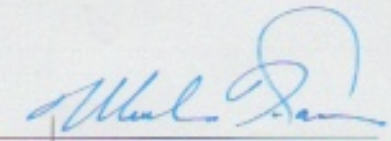
A paper submitted to the Faculty of the Joint Advanced Warfighting School in partial satisfaction of the requirements of a Master of Science Degree in Joint Campaign Planning and Strategy. The contents of this paper reflect my own personal views and are not necessarily endorsed by the Joint Forces Staff College or the Department of Defense.

This paper is entirely my own work except where documented in footnotes.
I acknowledge that Karen Hauser helped me reorganize my paper. All ideas and content, however, are my own.

Signature: 

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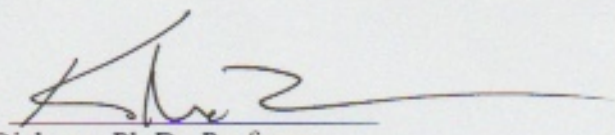
Signature: 
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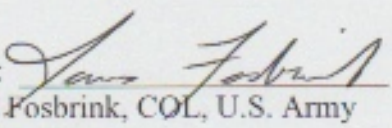
Signature: 
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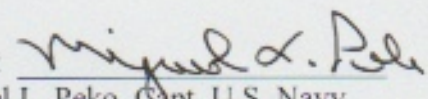
Signature: 
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ABSTRACT

The conception of the military space domain emerged from the ashes of World War II with the rapid escalation of tensions between the US and USSR. Over the past 60 years, the world, and most decisively the US, harnessed space-enabled effects for both military (communications, navigation, early warning, and intelligence) and civil purposes. There is no doubt: space capabilities are now essential to the modern world and represent a vital US national interest. The lack of comprehensive international agreements restricting non-WMD offensive space-based capabilities and the supreme asymmetric advantages space capabilities provide the US military represent an opportunity and incentive for potential competitors to weaponize space. Open source intelligence indicates Russia and China are already advancing counterspace capabilities that could threaten US satellite constellations.

In order to offer sound proposals to balance the current environment, one must understand the historic context of the domain. This thesis examines the evolution of the space domain through three phases and provides recommendations for the future US space posture through three lenses: redesigning a space strategy based on deterrence, reviewing organizational structure in order to optimize efficiency, and completing a space-based capability review that supports policy and strategy that enables stability in the domain and avoids a security dilemma in space.

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INTRODUCTION

"Whereas those who have the capability to control the air, control the land and sea beneath it, so in the future it is likely that those who have the capability to control space will likewise control the earth's surface" General Thomas White, Chief of Staff, USAF[1]

Over the millennia, humans have gazed toward the heavens in awe and wonder, inspiring hope and adventure. Through study of the stars, humans have traced history and made scientific discoveries. Man has touched the moon and seeks interplanetary journeys. Space has inspired many of the most profound achievements over the past 50 years and, as the International Space Station proves, space has been the common ground for some of the world's most peaceful international engagements.

However, like every domain that involves human interaction and competition, space has also raised security concerns. Following the Soviet Union's (USSR) launch of *Sputnik,* the first artificial satellite, in 1957, the space domain became open to national security engagement. The United States responded to the Soviet advances by developing technology for satellite employment, space exploration, and ballistic missile delivery. President John F. Kennedy described the importance of technological superiority in space in a 1962 speech, asserting "our leadership in science and in industry, our hopes for peace and security, our obligations to ourselves as well as to others, all require us . . . to become the world's leading space-faring nation."[2]

This paper examines the evolution of the military space domain from a neutral field of competition to a potential battlefield in three distinct phases. The two superpowers laid the foundation through decades of peaceful use characterized by

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[1] Department of the Air Force, *Air Force Doctrine Document 2-2.1: Counterspace Operations*, (Washington DC: Department of the Air Force, 4 August 2004), 7.
[2] President John F. Kennedy, *Address at Rice University on the Space Effort*, September 12, 1962, accessed October 12, 2017, https://er.jsc.nasa.gov/seh/ricetalk.htm.

international agreements and bilateral-national treaties. This was followed by a period of space power, in which the US, as the sole superpower, enjoyed the unlimited advantages of space capabilities in peace and war. However, with the launch of China's first anti-satellite weapon in 2007, the current period of space mutability began, where multiple state and commercial actors compete and where space assets may no longer be considered absolutely secure. Each phase has left a unique imprint on perspectives of the space domain, as well as shaping the understanding of its character and role in national security.

The consideration of weapons in space has existed since the opening of the space domain, yet the trend has been for space-faring states to respect the historic norms of a free and peaceful use of space. The question remains: as the ultimate "high ground," can a space-faring power risk its security, especially when space assets are considered a critical component of its national power? A precarious balance exists as long as no state violates the neutrality of space by placing weapons in space, or deploying destabilizing numbers of terrestrial weapons capable of destroying targets in space. Space has been militarized -- space vehicles are routinely used to support military operations for navigation, communications, and early warning of a strategic attack -- but not in violation of any international agreements.

During the Cold War, the USSR and US sponsored numerous international agreements, both bilaterally and via the United Nations (UN), to govern the peaceful use of space. Under UN auspices, the 1967 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (more commonly known as the Outer Space Treaty) was ratified by

numerous states, most notability the US, USSR, France, the United Kingdom, and China. Emerging space powers including India, Pakistan, Japan, and Ukraine have also ratified this treaty. North Korea is a notable exception to the list. This treaty decrees space as a global commons and declares all states have free access for the peaceful use of space. It forbids any state from placing weapons of mass destruction (WMD) in orbit.[3] The Strategic Arms Limitations Talks (SALT) and Intermediate-Range Nuclear Forces Treaty (INF) continued to codify and build on the restrictions of WMD in space. In addition, article XII of the INF treaty, which was signed in December 1987, stipulated that any attack on satellites constituted an attack on strategic response forces and could trigger a nuclear retaliation. Although both the US and USSR continued to develop the means to militarize space, both superpowers refrained from placing weapons in space.

Advances in technology, mostly by the US, led to the deployment of highly capable Intelligence, Surveillance, and Reconnaissance (ISR), communications, weather, early warning, and navigation constellations. Operations URGENT FURY (1983) and JUST CAUSE (1989) highlighted the advantages offered by navigation and satellite enabled communications. As these capabilities expanded, the US military, and modern military forces in general, became increasingly dependent on space-based systems.

During Operation DESERT STORM (1991), constellations of ISR, navigation, and weather satellites enabled General Norman Schwarzkopf, the operational commander, unparalleled capabilities to support the maneuver and employment of forces throughout the battlespace. Spectacular visual recordings of precision weapons, guided

[3] "Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies," January 27, 1967, *United Nations Treaty Collection October 10, 1967 610*, 208.

by satellites, hitting targets thrilled the world and highlighted American technological superiority. Militarized space assets soon became a cornerstone of US and NATO military operations. No other state has exploited the neutrality of space more effectively than the US. Following DESERT STORM, China was quick to attribute US military dominance to space capabilities. In military and academic writings over the next ten years, the Iraq war was termed the first "space war," and Chinese military strategists recognized that US dependence on space assets represented an "Achilles heel."[4] It is a military axiom that such dependencies create vulnerabilities that a potential adversary can exploit.

The US Air Force, as the leading service branch for space, has recognized the risks associated with an over dependency on the space domain and it has recently embarked upon numerous initiatives to bolster space defense and resiliency. Air Force Space Command (AFSPC) began a complete overhaul of the space operations culture in 2015 through the Space Mission Force program. The goal was to change the space operator's mindset to a warfighter mentality and prepare the force for future operations in a potentially contested, degraded, or operationally limited space domain. This paradigm shift represents, for now, a prudent move toward accepting the possibility of potential adversaries presenting real threats to space assets. Planners may no longer make the assumption that space assets are unthreatened.

Even as the militarization of space was taking place, a greater transformation was occurring in the global economy. Space capabilities are now essential for farming,

[4] Harch Vasani, "How China is Weaponizing Outer Space," *The Diplomat*, January 19, 2017, accessed October 26, 2017, https://thediplomat.com/2017/01/how-china-is-weaponizing-outer-space/.

banking, and transportation, as well as for national and regional utility infrastructure.[5] Space enabled capabilities are essential to the modern world. It is an accepted truism that any significant interruption or destruction of satellite support functions would have a massive and near-instantaneous effect on any major power's military effectiveness and economic stability. The US, like all other developed countries, deliberately and coherently migrated to space-enabled functionality. Far beyond other countries, however, space for the US became a force multiplier in military power projection, while simultaneously creating significant economic and commercial advantages. This dependence on space relies on the assumption that space will remain neutral and free from hostile threat. For the strategist, the logical conclusion is that the US space architecture is a vital national interest. While actions can be taken to diversify and grow resilience via terrestrial-based infrastructure, these cannot fully replace the inherent benefits gained via the use of the space domain.

There are indications that potential adversaries are advancing counterspace capabilities that could threaten US space constellations. The lack of comprehensive international law or agreements between the current military space-faring nations to restrict non-WMD capabilities represents an opportunity for the weaponization of space and the neutralization of the American capability for global military dominance. This paper will examine how the US became the premier space power and provide recommendations for the future US space posture by addressing three key aspects: redesigning a space strategy based on deterrence, reviewing its organizational structure in order to optimize its efficiency, and completing a space-based capability review to ensure

[5] Scott Large, "National Security Space Collaboration as a National Defense Imperative," *High Frontier*, August 2008, 3.

the on-orbit systems support the policy and strategy that enable stability in the domain. These recommendations are intended to establish a US position that is best able to confront future threats, while avoiding a security dilemma in space. The strategic objective for the US must be to sustain a neutral, accessible, stable space domain for all counties that is free of devastating kinetic attacks. The US must lead the way forward. Its space posture must be deliberate, responsible, restrained, and appropriate to ensure that the world can continue to enjoy the vast benefits space provides and ensure freedom of use for all states.

CHAPTER 1 – PHASE I: *BIRTH OF THE SPACE DOMAIN: AN UNCHARTED FUTURE*

"In the long haul our safety as a nation may depend upon our achieving 'space superiority,'" General Bernard Schriever, Commander, Air Research and Development Command, 1957

The conception of the space domain emerged from the ashes of World War II with the rapid escalation in tensions between the United States (US) and Soviet Union (USSR). Wernher von Braun, the father of the ballistic missile, recognized the military potential of space. He envisioned a rocket in Earth orbit where, "the whole of the Earth's surface could be continually observed."[1] Von Braun was a top priority asset for the US to evacuate from Germany before the USSR could capture him at the end of World War II. This first phase of development of the space domain continued from the end of World War II until the end of the Cold War in 1989. A power struggle between services dominated military efforts to determine the branch of service most suited to lead space development. The creation of the Air Force as a separate branch of service was in part a response to countering the new capabilities seen at the end of World War II: guided missiles, jet aircraft, and long-range bombers. The US space program began within the military, making the militarization of space inevitable.

The first US military satellite program looked at the feasibility of an "efficient satellite reconnaissance vehicle" to provide strategic early warning as a matter of "vital strategic interest to the United States."[2] Progress was slow until the USSR's launch of *Sputnik* in 1957, which dramatically changed perceptions and accelerated US satellite and

[1] Paul B. Stares, *The Militarization of Space* (Ithaca: Cornell University Press, 1985), 24.
[2] J.E. Lipp and R. M. Salter, "Project Feedback Summary Report", RAND Report R-262, March 1, 1954, accessed December 29, 2017, https://www.rand.org/pubs/reports/R262z2.html, 149.

missile technology. James Killian, appointed as the first Special Assistant to the President for Science and Technology, portrayed the mood of the country following the launch of *Sputnik*. "As it beeped in the sky," he realized, "*Sputnik I* created a crisis of confidence that swept the country like a windblown forest fire. Overnight there developed a widespread fear that the country lay at the mercy of the Russian military machine and that our government and its military arm had abruptly lost the power to defend the mainland itself."[3]

Stung by the Soviet propaganda victory, and fearing further Soviet advances, the Eisenhower administration campaigned heavily to maintain the image that the US envisioned a peaceful use for space, and actively discouraged efforts by all three branches of service to develop anti-satellite technology. A 1956 National Security Council directive stated that, "the purpose of the US, as part of an armaments control system, is to seek to assure that the sending of objects into outer space shall be exclusively for peaceful and scientific purposes."[4] In an effort to preserve this focus, the Eisenhower administration made an early decision to divide space into separate military and civilian entities. The civilian arm was NASA, created in March 1958; however, very little funding and direction was given to this new organization. The US military focused on the need to develop missile delivery and satellite technology to enhance military capabilities. As military technology advanced and made both reconnaissance satellites and missile delivery systems a reality, political guidance began to change.

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[3] James R. Killian, *Sputnik, Scientists, and Eisenhower: A Memoir of the First Special Assistant to the President for Science and Technology*, (Cambridge, MIT Press, 1977), 7.
[4] McGeorge Bundy, *Summary of Foreign Policy Aspects of the U.S. Outer Space Program*, Chronology of Development of U. S. Policy with Respect to Outer Space, (Johnson Library Austin, TX: 7 Jun 1962), 8.

Prior to 1958, the rhetoric from both the USSR and US emphasized the non-military use of space; but both governments slowly changed their tune, focusing instead on the peaceful or nonaggressive nature of space. The US began this shift as reconnaissance satellite technology progressed with the successful launch of *CORONA* in 1959. During conferences aimed at developing international agreements on space, the USSR vigorously protested its legality. Ironically, a simultaneous protest of U-2 reconnaissance aircraft over-flights of the USSR came to a head and the door to agreements allowing reconnaissance satellites was opened by Soviet Premier Nikita Khrushchev himself, who distinguished between air and space reconnaissance efforts by stating " . . . any nation in the world who wants to photograph Soviet areas by satellite would be completely free to do so."[5] The following year, 1961, the Soviets successfully launched a photoreconnaissance satellite, *Zenit*. Without acknowledging the existence of a reconnaissance program capable of monitoring each other, the US and Soviet Union tacitly accepted their legality. During the 1960s, the US and Soviet focus remained on international verification of space activities and prohibition of space-based WMD. The United Nations (UN) formed the Committee on Peaceful Uses of Outer Space in December 1959, but no other formal action was taken.

At the onset of the Kennedy administration in early 1961, space policy efforts included designating the Air Force as responsible for research and development on reconnaissance data from satellite sources. NASA was invigorated and assigned manned space flight. During this time a veil of secrecy over space operations, both civilian and military, began with the classification of many programs, as well as initiating measures to

[5] Dwight D. Eisenhower, *Waging Peace: the White House Years A Personal account 1956-1961*, (Oxford: Oxford University Press, 1965), 556.

deny access, such as eliminating advanced launch notifications. At the same time, the State Department began working to legitimize the space reconnaissance program by working within international law. President Kennedy issued National Security Action Memorandum (NSAM) 156, which formed an interagency committee to coordinate the position of the US prior to entering into international negotiations. To frame negotiations, the main points agreed upon in this committee, and approved by President Kennedy in NSAM 183, included the non-disclosure of US space reconnaissance capabilities, rejection of the "non-military" use designation of space (similar to the high seas), and recognition in international law that observation of the earth was allowable.[6]

In 1962 and 1963, two documents established the first international agreements on the conduct of states in outer space. First, a UN resolution (not a formal treaty) adopted by the General Assembly, the Declaration of Legal Principles Governing Activities of States in the Exploration and Use of Outer Space, established the basic principle that outer space is not subject to appropriation by claim of sovereignty and that space activities and space use should be carried out in the interest of maintaining international peace and security.[7] The second agreement between the US, Great Britain, and USSR was the Limited Test Ban Treaty signed in August 1963. This agreement, which is still in effect, prohibits nuclear tests in outer space or under water.[8] This treaty was later signed by current prominent space-faring nations including China, India, France, Iran, and Israel.

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[6] National Security Action Memorandum No. 183, *Space Program of the United States*, August 27, 1962, John F. Kennedy Library Cambridge, MA: accessed December 8, 2017, https://www.jfklibrary.org/Asset-Viewer/ztdT46cq8UisotWneliTEg.aspx.

[7] United Nations General Assembly, December 13, 1963. *Declaration of Legal Principles Governing Activities of States in the Exploration and Use of Outer Space*, New York: UN.

[8] "Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water," August 5, 1963, accessed October 16, 2017 https://www.state.gov/t/isn/4797.htm.

International law, regulated through the UN regarding the use of space, formally began with the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, which was initially signed in 1967 and ratified by all major state actors in the space domain, most prominently the US, USSR, China, Japan, Great Britain, India, and France. This document, informally known as The Outer Space Treaty, is modeled after the 1959 Antarctic Treaty that provides for the freedom of scientific investigation and exchange of observations. The Space Treaty includes provisions prohibiting the placing of Weapons of Mass Destruction in orbit, and outlines international liability for damage to another state party by objects in air, space, or outer space.[9] The treaty has no registration or verification provisions; instead, the US and USSR relied on space-tracking systems to provide verification. Several additional agreements have been grouped together under the Space Treaty, including the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space. None of these agreements addressed development of anti-satellite (ASAT) weapons employing non-nuclear warheads.

The Eisenhower and Kennedy administrations publically sought political and legal methods to solve the vulnerability of US reconnaissance satellites. ASAT technology was viewed as an act of escalation, encouraging the USSR to respond in kind. However, since proposed defense systems were insufficient to protect the fragile

[9] "Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including Moon and Other Celestial Bodies," January 27, 1967, accessed October 24, 2017, https://www.state.gov/t/isn/5181.htm.

satellites, both the US and USSR secretly studied the development and testing of ASAT technology.

The first full-scale effort by the US to develop an ASAT capability was the SAINT (satellite interceptor) program in 1960. The system design focused on inspecting and disabling a satellite with an optional kill mechanism. This ASAT technology emphasized target identification in addition to potential destruction. Although the program was cancelled, the follow-on Nike Zeus program provided the first successful satellite intercept in 1963 from Kwajalein. Its successor, the Thor system, conducted several successful ASAT tests without an actual nuclear warhead detonation in order to stay within the limits of the 1963 Limited Test Ban Treaty. US research later transitioned to non-nuclear warhead and kinetic (or impact) technology. Funding for many of these programs significantly decreased during the Vietnam War.

The Soviet Union began testing satellite interceptors utilizing a co-orbital approach that employed conventional explosives launched into the same orbit as the target satellite to damage or destroy with a proximity conventional explosion.[10] The Soviet Union tested satellite interceptors between 1963 and 1968, successfully destroying a previously launched rocket in 1968.

The development of ASAT technology led the superpowers to sign the 1972 Convention on International Liability for Damage Caused by Space objects. Article II and III of the agreement established the requirement to pay for damages caused by space objects. Article III states that in the event the damage to an object elsewhere then the

[10] Laura Grego, "A History of the Anti-Satellite Programs", *Union of Concerned Scientists* (January 2012): 3, accessed January 2, 2018, https://www.ucsusa.org/sites/default/files/legacy/assets/documents/nwgs/a-history-of-ASAT-programs_lo-res.pdf

surface of the earth, the launching State, "shall be liable only if the damage is due to its fault or the fault of person for whom it is responsible."[11] Although this document appeared to address ASAT threats, both the US and USSR continued to research ASAT technology.

The 1980s saw a significant increase in US research and development of ASAT and related missile defense technology. In June 1982, the United States announced the development of the Air-Launched Miniature Vehicle (ALMV), launched from an F-15 fighter jet at high attitude, intended for a kinetic kill of a satellite at any point in its orbital path. The following year, President Ronald Reagan announced that the US would develop a Strategic Defense Initiative designed to defend against ICBMs attack that would also have intrinsic ASAT capabilities. The Air Force successfully tested the ALMV system in 1985 against an aging satellite system, but the space debris field that resulted prompted a Congressional ban on ASAT testing in the same year. The Soviet Union had observed a self-imposed ban on ASAT testing, but resumed testing in 1987. As the Cold War came to a close, US research and development focused on other means of disabling satellites, including the use of directed electromagnetic energy.

This period from the end of World War II to the end of the Cold War was characterized by corresponding technological advancements of the two dominant space faring nations, the US and USSR. International agreements allowed for the rapid development of satellite systems benefiting both civilian and military aims. From the onset, the space environment developed as a militarized domain. Space technology supported and enhanced military operations through navigation, weather, ISR, and

[11] United Nations, C*onvention on International Liability for Damage Caused by Space Objects*, March 29, 1972, New York: UN.

communications. At the same time, ASAT technology to limit or destroy an adversary's space assets developed at a measured rate. At the end of the Cold War, just as the US started to look at vastly advanced ASAT capabilities, a new phase in the evolution of the space domain began.

CHAPTER 2 - PHASE II: *POST COLD WAR SPACE: US PRIMACY*

"The mastery of outer space will be a requisite for military victory, with outer space becoming the new commanding heights for combat," Captain Shen Zongchang, Chinese Naval Research Institute, 2001

The fall of the Soviet Union (USSR) and resulting change in the international landscape resulted in the proliferation of space assets for both military and civilian enterprises. The end of the Cold War also brought the end to many anti-satellite (ASAT) programs. President George H.W. Bush initially retained the ASAT programs under the Reagan Strategic Defense Initiative program, in particular the Mid-Infrared Advanced Chemical Laser program, but Congress banned the use of the laser in 1991, and research and development programs transitioned to missile defense capabilities.[1] As the sole superpower, the United States (US) clearly dominated the space domain and focused on increasing the utility of space assets, while developing technology to enhance military operations.

By the end of the century, space assets helped make the US the most lethal, responsive, and dominant military in the world, but space policy did not keep pace with space asset expansion and sophistication. Indeed, US space dominance was so complete that little attention was paid to satellite security. The Clinton administration issued relatively little guidance on space from 1992-2000, although President Bill Clinton declared that unimpeded access to the use of space was "essential for protecting US national security, promoting our prosperity, and ensuring our well-being."[2] Despite this assertion, the Clinton administration busied itself with administrative matters, reducing

[1] Daniel A. Gallton, *The Challenge of Small Satellite Systems to the Space Environment*, (Monterey, CA: Naval Post Graduate School, March 2012), 32-33.
[2] US President, *National Security Strategy for a New Century*, (The White House, October 1998), 26.

the redundancy of commercial and military space assets, increasing access to more government and commercial users, and authorizing the expanded use of commercial sector resources. ASAT research during this time continued to be largely focused on missile defense systems with intrinsic low earth orbit intercept capabilities.

The Clinton administration assertion on unimpeded access to space was highlighted in the National Space Policy (NSP) of 1996. The NSP is an instrument of the President, drafted by the Science and Technology Council, and submitted to Congress for use in the legislative process and funding allocation. The first NSP was approved in 1978 by President Carter, and then updated by President Reagan in 1982 and 1988, and again by President Clinton in 1996. Each version of the policy included a reference to the "interference with operational space systems . . . as an infringement upon sovereign rights."[3] Despite the strong phrasing, no significant change in funding or organization changes resulted from the policy.

During the final year of the Clinton administration, congressional concern regarding US space utilization, organization, and education led to the formation of the Space Commission. The National Defense Authorization Act for Fiscal Year 2000 called for the formation of a commission to assess changes that would strengthen US national security. The 2001 Space Commission recommended that the "US government should vigorously pursue the capabilities called for in the NSP to ensure that the president will have the option to deploy weapons in space to deter threats, and, if necessary, defend

[3] President Jimmy Carter, *Presidential Directive/NSC-37,* "National Space Policy," May 11, 1978, accessed January 15, 2018, https://fas.org/spp/military/docops/national/nsc-37.htm.

against attacks on U.S. interests."[4] This emphasis on expanding US capabilities to defend space assets and President George W. Bush's desire to pursue missile defense employment necessitated the withdrawal of the US from the Anti Ballistic Missile Treaty.

Meanwhile, a number of nonbinding United Nation (UN) resolutions recognized the benefits and legality of remote sensing of Earth from outer space, the use of nuclear power sources in outer space, and reinforced the principle of freedom of outer space with access to space shared equally between all countries. During the 2006 Conference on Disarmament, The People's Republic of China and the Russian Federation published a Working Paper entitled "Existing International Legal Instruments and the Prevention of the Weaponization of Outer Space." This paper recognizes the obvious: that current treaties and agreements are "unable to effectively prevent the testing, deployment, and use of weapons other than WMD in outer space," and emphasizes that none are "relevant to the question of use of force, or threat of use of force against objects in outer space."[5]

The document concludes with a recommendation to negotiate international legal instruments to prevent the weaponization of space. The US has continually opposed calls for additional international regulation stating, "the security and well being of many nations depend on the ability to operate in space . . . all Member States have the inherent right of individual and collective self-defense. The global responsibilities of the US . . . require that this right be exercised both on the Earth and above it."[6] The US concern was

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[4] U.S. Congress. Commission to Access US National Security Space Management and Organization. *Report of the Commission to Assess United States National Security Space Management and Organization*. (Washington, D.C.: U.S. Government Printing Office), xii.

[5] People's Republic of China and The Russian Federation, "*Existing International Legal Instruments and Prevention of the Weaponization of Outer Space*," May 22, 2006, Conference on Disarmament: New York, NY.

[6] Eric M. Jarvis, "Remarks to the Conference on Future Security in Space: Commercial, Military and Arms Control Trade-offs," May 29, 2002, New York, NY.

that any defensive systems would be restricted because they are virtually indistinguishable from offensive systems.

Meanwhile, US military operations since the end of the Cold War have been characterized by the integration of space assets and capabilities into all areas of combat. Military communications satellites, weather data, and early delivery of still imagery from International Maritime Satellite Organization (INMARSAT) satellites enhanced coordination efforts and provided an unprecedented level of situational awareness for military planners. Military use of space accelerated in Operation DESERT STORM in 1991 with full integration of space assets and commanders with robust on-orbit constellations and the organic spacecraft flexibility to alter operations to support specific needs of the terrestrial warfighter.[7] Operation IRAQI FREEDOM, Operation ENDURING FREEDOM, and the ensuing Global War on Terror, have all been space reliant. As these capabilities advanced, other space powers noted both the strengths and vulnerabilities provided by space assets, and correspondingly increased efforts to develop their own capabilities and countermeasures to meet them.

Russia continued to develop co-orbital ASAT technology. At the end of the Cold War, Russia largely shifted emphasis to scientific exploration and maintaining technological expertise to compete in the commercial space industry. US and Russian scientists enjoyed unparalleled cooperation and technology sharing. While diplomatically pursuing cooperative international agreements to limit US capabilities to field defensive

[7] Thomas M. Moorman, Jr., presentation to Gen E.P Rawlings Chapter, Air Force Association, Minneapolis, MN, "Space…The Future is Now," 17 October 1991, accessed December 28, 2017, http://www.au.af.mil/au/awc/space/books/spires/spires.pdf, 39.

(but also potentially offensive) systems in space, Russia also increased emphasis on both its commercial and military space program.

The commercial benefits of space systems attracted an increasing number of players. China, India, France, Japan, and Israel were the most prominent. Systems initially designed to support military or government operations were modified to commercial and economic activities. Globalization, the dominant trend of the last years of the twentieth century, was only possible through the development of space assets.

It was China, however, that made the most significant advances. The Chinese space program is directed and funded from the People's Liberation Army.[8] In 1999, China launched the China-Brazil Earth Resources satellite, providing China's first surveillance capability. Since then, China has collaborated with several other countries on space technology development including Canada, France, Germany, India, South Korea, the United Kingdom, and the US. Despite its peaceful development programs, a 2002 US Department of Defense (DoD) analysis report noted that "Chinese leaders view ASAT and offensive counterspace systems as inevitable while striving to acquire various forms of technologies which could be used to develop active ASAT capabilities."[9] On January 11, 2007, China launched a kinetic ASAT weapon, destroying an aging weather satellite, becoming only the third country in the world (after the US and USSR) to destroy a satellite successfully with this technology.[10] Much like the US kinetic experiment, the result was double-edged. The successful test demonstrated an ASAT capability, but the

[8] Steven J. Markovich, "Space Exploration and U.S. Competitiveness," *cfr.org*, December 5, 2014, accessed December 15, 2017 https://www.cfr.org/backgrounder/space-exploration-and-us-competitiveness.
[9] Bert Chapman, "Chinese Military Space Power: U.S. Department of Defense Annual Reports," *Astropolitics: The International Journal of Space Politics & Policy*, 14 (1), 2016, 74.
[10] Jeffrey L. Fieldler, "China's Space and Counterspace Programs," *Hearing before the U.S.-China Economic and Security Review Commission*, February 18, 2015, (Washington DC: Government Printing Office, 2015), 8.

destruction of the satellite created a hazardous debris field that interferes with existing space assets, as well as future systems.

The Chinese ASAT demonstration marshaled in a new phase of the space domain evolution. As the dominant space power, the US developed into a space dependent nation for both its military and economic supremacy. Other countries also entered into the space domain, including China, which has demonstrated an interest in countering or limiting another country's space assets. The global reliance on space effects has led to increased calls for international cooperation and avoidance of a catastrophic weaponized space race. As the space domain became more congested, the US has become more interested in protecting its assets in space. The world entered a new and more complicated space age--one caught in the balance between reliance and vulnerability.

CHAPTER 3 – PHASE III: *CONTEMPORARY FOREIGN THINKING*:

REBALANCING THE STRATEGIC EQUATION

"*Over the past few years we have recognized that space and information are not only enablers, but core warfighting competencies,"* Donald H. Rumsfeld, Secretary of Defense, 2003

Since the successful launch of a Chinese anti-satellite (ASAT) test in 2007, the space domain has become increasingly more complex. Other space powers have rapidly advanced technologies to challenge or minimize the United States (US) dominance. Simultaneously, international rhetoric regarding legal agreements regulating the weaponization of space has increased, while worldwide reliance on space assets continues to expand. As of August 2017, there are over 1,000 operational satellites operated by more than 80 countries providing vital business, communications, and military capabilities.[1] The 2001 Space Commission report noted, "with growing commercial and national-security use of space, US assets in space and on the ground offer many potentially vulnerable targets."[2]

Following the Chinese ASAT test, the Bush Administration authorized the destruction of an incapacitated US satellite on February 21, 2008. Code-named Operation Burnt Frost, the US destroyed the satellite using an SM-3 missile launched from a U.S. Navy Aegis warship. The SM-3 is a vital component of the Aegis Ballistic Missile Defense System and was designed to intercept short and intermediate range ballistic missiles. The heat-seeking missile was significantly modified to target a satellite

[1] Union of Concerned Scientists, "UCS Satellite Database," accessed January 1, 2018, https://www.ucsusa.org/nuclear-weapons/space-weapons/satellite-database#.Wk2AaCROmfA.
[2] U.S. Congress. Commission to Access US National Security Space Management and Organization. *Report of the Commission to Assess United States National Security Space Management and Organization*. (Washington, D.C.: U.S. Government Printing Office), xii-xiii.

with a higher intercept speed and different composition compared to traditional SM-3 targets.[3] The administration gave advance notification of the launch and explained that the satellite's destruction was necessary to prevent the possibility of the fuel tank surviving reentry, potentially spewing 1,000 pounds of frozen toxic hydrazine gas into the atmosphere and over an area roughly the size of two football fields.[4] Despite the non-threatening announcement, Russian and Chinese officials raised questions about a potential for a new space race and the weaponization of space. A Chinese foreign ministry spokesman raised concern about the "possible damage to security in outer space and to other countries."[5]

The Obama administration revised the previous Bush administration's 2006 National Space Policy, placing greater emphasis on international cooperation, but progress remained stagnant in that arena.[6] The Trump administration's space policy remains in development, but the reinstatement of the National Space Council will undoubtedly play a role. The Council resides in the Executive Office of the President and is accountable for aligning policy and strategy between the commercial, civil, and national security space sectors. A version of this advisory council, with a variety of designations, operated under previous administrations including Eisenhower, Kennedy, Reagan, and H. W. Bush. The last active National Space Council operating at the Executive Office level was dissolved in 1993.

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[3] George Galdorisi, "U.S. Navy Missile Defense: The Air-Sea Battle Concept and AEGIS BMD," Defense Media Network, accessed February 1, 2018, https://www.defensemedianetwork.com/stories/the-air-sea-battle-concept-and-aegis-bmd/.

[4] James Oberg, "U.S. Satellite Shootdown: The Inside Story", *IEEE Spectrum*, August 1, 2008, accessed December 1, 2017, https://spectrum.ieee.org/aerospace/satellites/us-satellite-shootdown-the-inside-story.

[5] "US missile hits 'toxic satellite'", *news.bbc.co.uk*, February 21, 2008, under "Russian suspicion," accessed December 15, 2017, http://news.bbc.co.uk/2/hi/americas/7254540.stm).

[6] U.S. President, "National Space Policy of the United States of America," June 28, 2010 (White House: US Government Printing Office, 2010): 3.

China and Russia, along with several other countries, continue to pursue approval of their version of the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force against Outer Space Objects Treaty, more commonly known as the PPWT, through the United Nations (UN) Committee on the Peaceful Uses of Outer Space. The Chinese-Russian proposed PPWT prohibitions continue to be a yearly pitch ritual at the UN. The US has remained opposed to this treaty because of its fundamental limitations, including the lack of prohibition of earth-based ASAT systems, unclear language regarding what constitutes use of force, and the difficulty in the verification process. From the US perspective, the failure to ban earth-based ASAT systems fails to address the largest threat to US space assets, while the space-based ban limits defensive systems that would have intrinsic offensive capabilities.

The 1993 Strategic Arms Reduction Treaty (START II) Article X provides continuation of an expired START I provision, "for the purpose of ensuring verification of compliance with the provisions of this Treaty, each Party undertakes: (b) not to interfere with the national technical means of verification of the other Party operating in accordance with this Article."[7] Interpretations of this provision vary; the consensus is that it prohibits attacks against space-based reconnaissance satellites capable of conducting verification of compliance.

Chinese military doctrine continues to focus on the US as the primary adversary. A complete translated copy of the most recent military strategy is unavailable, but recent organizational changes indicate an increased emphasis on space. Critically, the doctrine

[7] "Treaty between the United States of America and The Russian Federation on Measures for the Further Reduction and Limitation of Strategic Offensive Arms," April 8, 2010, accessed December 28, 2017, http://www.nti.org/learn/treaties-and-regimes/treaty-between-the-united-states-of-america-and-the-russian-federation-on-measures-for-the-further-reduction-and-limitation-of-strategic-offensive-arms/, 13.

reveals that the People's Liberation Army has officially designated space as a new domain and created an organization to command space forces.[8] Analysis of open-source documents indicates "the Chinese strategic community sees space as the ultimate high-ground, the key to military success on the terrestrial battlefield."[9] A Chinese analysis estimates that the US relies upon space assets for approximately 80 percent of communications capabilities and 70-80 percent of its intelligence collecting capabilities.[10] This reliance is not unique to the US, although more extensive than China, Russia, or other western nations, but nonetheless is a major factor in US military dominance, and therefore it is also a target.

Chinese strategies to exploit US space dependency are multi-functional, and include utilizing ASAT direct ascent kinetic kill systems, co-orbital micro-satellites to disable target satellites, and directed energy weapons, such as lasers and microwave weapons.[11] Since the 2007 test, China has refrained from actual intercepts of targets in space, opting instead to only approach the target, but has completed three tests in 2013, 2015, and 2016 of two different systems. The Dong Neng-2 was test launched into nearly geosynchronous orbit where many US ISR satellites reside.[12] The Dong-Neng-2 is a dedicated ASAT system designed to destroy a satellite utilizing a direct impact or kinetic kill, rather than a conventional or nuclear warhead. The Chinese Aolong-1, launched in June 2016, is a small satellite equipped with a robotic arm with the stated purpose of de-

[8] Kevin Pollpeter, "Space, the New Domain: Space Operations and Chinese Military Reforms," *Journal of Strategic Studies,* 39 (2016), 710.
[9] Harch Vasani, "How China is Weaponizing Outer Space," *The Diplomat,* January 19, 2017, accessed October 26, 2017, https://thediplomat.com/2017/01/how-china-is-weaponizing-outer-space/.
[10] Ibid.
[11] United States – China Economic Security Review Commission, *China's Space and Counterspace Programs* (Washington, DC: Government Printing Officer, February 18, 2015), 16-18.
[12] Vasani, 2.

orbiting space debris; however, from a military perspective the system has the ability also to serve as an ASAT, with the means to disable satellites it rendezvous with.[13] As with many space systems, seemingly benign assets can augment military capabilities, due to the fact that disabling satellites is exceptionally easy as the systems are without defensive capabilities or armor.

Current analysis of the Russian Federation military demonstrates retained lessons from the Cold War with an inherent distrust of US intentions in outer space. Admiral Cecil Haney, US Strategic Command Commander noted that "Russia's 2010 military doctrine emphasized space as a crucial component of its defense strategy and Russia has publically stated they are researching and developing counterspace capabilities to degrade, disrupt and deny other users of space."[14] Despite the emphasis on "researching and developing," Russia has also periodically tested ASAT capabilities. The most recent successful test occurred in December 2016 involved a PN-19 Nudol missile designed to threaten US communication and navigation satellites. The latest English version of their doctrine is from 2014 and contains language noticeably political in nature and is intended for an external audience. Reoccurring themes regarding space include continued emphasis to curb missile defense to protect global security, compliance with previous international agreements, development of international agreements to outlaw space

[13] David D. Chen, "China's Advanced Weapons", (Washington, D.C., Government Printing Office, February 23, 2017) *Testimony before the U.S.-China Economic and Security Review Commission*, 1.
[14] Franz-Stefan Gady, "US Admiral Warns of China's and Russia's Growing Space Weapons Arsenal", *The Diplomat*, January 26, 2016, accessed December 4, 2017, https://thediplomat.com/2016/01/us-admiral-warns-of-chinas-and-russias-growing-space-weapons-arsenal/.

weapons and "deployment and maintenance of strategic . . . space devices that support the activities of the Armed Forces."[15]

The number of states operating in the space domain, as well as the number of commercial interests and non-government actors has increased significantly since the end of the Cold War. Non-government users of space present a unique security challenge. Commercial and academic/scientific satellites provide a tremendous benefit for the users, but there are few established norms regarding size, composition, and contingency for deorbiting, minimizing debris, or frequency de-confliction. International regulations on these issues remain unclear and insufficient. Many nations (including the US) have moved to dual use (civilian and military) satellite systems. This policy has the advantage of reducing redundancy, providing valuable resources for the civilian sector and other government agencies, and limiting costs. On the other hand, the US is the only country capable of doing this to any degree, and such consolidation raises security concerns and creates more vulnerabilities for military operations.

Iran in 2009 and North Korea in 2012, both hostile to the US and other Western nations, have pursued their own space programs that may have a dual use. The Iranian Space Agency has experienced numerous starts and stops since its inception in 2004. The program has launched four satellites successfully and briefly considered a manned flight program, but scrapped it due to budget constraints. The Iranian program is focused on providing national prestige and further developing ballistic missile technology with a dual purpose of ICBM delivery and satellite launch or ASAT capability. North Korea

[15] Vladimir Putin, *The Military Doctrine of the Russian Federation,* The Embassy of The Russian Federation to the United Kingdom of Great Britain and Northern Ireland, accessed February 1, 2018, https://rusemb.org.uk/press/2029.

launched a KMS-4 satellite in February 2016, reported to be an earth observation satellite intended to provide images of crops and improve crop yield.[16] North Korea's investment in launch facilities and concealment efforts of its space program raises concerns about the actual payloads being launched.[17] The primary fear, given the level of advancement evident at the launch site, is that KMS-4 technology could be used to deliver a nuclear warhead into space or to further rocket technology to deliver an ICBM. Both the Iranian and North Korean space programs are in early development stages, but rapidly advancing.

The contemporary space domain is characterized by a growing complexity and the openly declared intent of Russian and China to challenge US military space dominance. Chinese military training uses a paraphrase of President Kennedy to teach the danger of US dominance in space, "whoever controls space controls initiative in war." [18] These conditions may present a new era of military competition in space. The US must respond to ensure that it maintains its effectiveness in the space domain.

[16] Ibid.
[17] Jim Oberg, "It's Vital to Verify the Harmlessness of North Korea's Next Satellite," *The Space Review*, (February 6, 2017), accessed December 17, 2017, http://www.thespacereview.com/article/3164/1in.
[18] Larry M. Wortzel, "The Chinese People's Liberation Army and Space Warfare", *Asia, Foreign and Defense Policy*, (October 17, 2017), accessed December 28, 2017, http://www.aei.org/publication/the-chinese-peoples-liberation-army-and-space-warfare/.

CHAPTER 4: *CONTEMPORARY US THINKING: A PIVOT IN PHILOSOPHY*

"It is no use saying, 'We are doing our best.' You have got to succeed in doing what is necessary." Sir Winston Churchill

Over the past 60 years, the United States (US) has mastered the militarization of space and the corresponding space-enabled warfighter effects. In recent years potential competitors have swelled in number. The result is a modern space domain that is increasingly competitive, complex, and congested. Gen Rupert Smith, in his book The Utility of Force, argues that today's strategic environment is an endless cycle of cooperation, competition, and conflict.[1] If true, then it is not surprising that space is a natural venue for this cycle. Clearly, space provides an arena for nation-state competition below the threshold of conflict or war. This is the antithesis of the traditional desire of the US for a peaceful space environment, yet one that is also capable of supporting terrestrial military operations. The potential that space can be an actively contested environment will force a revision of its strategy for space.

This chapter will highlight DoD's initial efforts to respond to the potential new threats in the space domain, while suppressing or limiting the risks of escalation. Over the past 20 years, the US has extensively studied the challenges through initiatives such as the 2001 Space Commission and the Space Portfolio Review, and has implemented numerous projects, such as Operationally Responsive Space, and initiated transformative endeavors such as the Space Mission Force and the creation of the Joint Interagency Combined Space Operations Center (JICSpOC). These efforts represent the event horizon of what is perceived as an impending paradigm shift in space militarization.

[1] General Rupert Smith, *The Utility of Force* (New York: Alfred A. Knopf, 2005), 183.

While the success of each may be debated, they collectively represent recognition that the environment in space is becoming increasingly less benign and that a change in strategy is necessary.

The House and Senate Armed Service Committees appointed a Space Commission in 2000 and charged it to assess the management of US space activities in support of national security.[2] The Space Commission's report represents the single most comprehensive study on US space policy and continues to have an enduring influence on US strategy and organizational changes. It differed from the previous national policy level space assessments because it was directed by Congress, and not by the President or by the Department of Defense (DoD). The Commission concluded that the US security and economic well-being were dependent on the ability to operate in space and that US should "develop and deploy means to deter and defend against hostile acts directed against US space assets."[3] The public document was vague on the means recommended to defend on-orbit space assets, but it was clear that the US should not limit its options. The Commission asserted, "the US reserves the rights to be able to retaliate and destroy either ground sites or satellites, if necessary."[4] The Commission report also highlighted the growing association between government and commercial activities in space and the opportunities and synergies available through collaboration and coordination. These synergies, while advantageous and cost beneficial could also create vulnerabilities due to diverse standards of system design and potential conflicts of prioritization during conflict.

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[2] U.S. Congress. Commission to Access US National Security Space Management and Organization. *Report of the Commission to Assess United States National Security Space Management and Organization*. (Washington, D.C.: U.S. Government Printing Office), vii.

[3] Ibid, vii.

[4] Ibid, 28.

As this paper has noted, none of these findings are new. These concerns have been repeated in numerous policy and space strategy assessments beginning with the 1978 National Space Posture.

What is important to note, however, is that the commission used clear and unambiguous language to describe the risk posed to US space assets. It assessed the threats "had been neither sufficiently persuasive nor gripping to energize the US to take the appropriate steps."[5] It summarized its assessment by stating, "the US is not as yet well prepared to handle the range of potential threats to its space systems."[6] The US must address this vulnerability gap in order to hedge against developing threats and clarify its deterrent intent. The lessons and recommendations of the 2001 Space Commission were profound at the turn of the 21st century, yet are even more applicable today, given the advancement and fielding of Russian and Chinese experimental spacecraft. While many of the Commission's organizational recommendations were either implemented or eclipsed by other decisions, those recommendations that pertain to space defense and deterrence remain mostly unfulfilled.

In 2006, the US Air Force launched the Operationally Responsive Space program. The concept, based largely on the 2001 Space Commission report, focused on developing inexpensive and responsive launch systems and low-cost small satellites to recover or augment critical space-based capabilities during conflict or emergency. It represents a prudent non-threatening practical response to maintain critical capabilities. Over the next decade, the program pushed beyond the norms of the US conventional space paradigm.

[5] Ibid, 23.
[6] Ibid, 23.

Although the program suffered numerous launch and on-orbit failures, it did successfully orbit multiple experimental satellites. While specific details remain classified, the publically announced primary capabilities were designed to meet Combatant Command gaps in Intelligence, Surveillance, and Reconnaissance, and Space Situational Awareness. This program's concept, known as resilient space, has been hampered by its prohibitive cost, yet research continues on "unconventional ideas . . . one of them is the airborne launch assist space access program, which uses unmodified F-15s to launch small satellites into orbit."[7]

Following President Barack Obama's direction, the DoD in 2014 accomplished an internal review and assessment of its space capability and organization to determine whether the US space architecture and posture were adequate in the current strategic environment. The critical analysis identified gaps in the space enterprise that subsequently contributed to the initiation of the Space Mission Force near the end of 2014 and standup of the Joint Interagency Combined Space Operations Center (JICSpOC) in 2015.[8] The Space Strategic Portfolio Review (SPR) studied the space postures of both the US and competitors and found that the strategic environment had changed and recommended an aggressive paradigm shift in US space culture.[9] The DoD's response has been strong and initially focused on the cognitive aspect of its

[7] Graham Kilmer, "Defense Leaders Make Renewed Push for Operationally Responsive Space," *National Defense* (September 2015): 1.
[8] John E. Hyten (Department of the Air Force, Air Force Space Command), *Space Mission Force: Developing Space Warfighters for Tomorrow*, (Colorado Springs, 2016); Department of Defense, *New Joint Interagency Combined Space Operations Center to be Established,* U.S. Strategic Command, accessed January 2, 2018, https://www.defense.gov/News/News-Releases/News-Release-View/Article/616969/new-joint-interagency-combined-space-operations-center-to-be-established/.
[9] Joan Johnson-Freeze, "Stopping the Slide Towards a War in Space: The Sky's Not Falling, Part 2, accessed February 1, 2018, https://breakingdefense.com/2016/12/stopping-the-slide-towards-a-war-in-space-the-skys-not-falling-part-2.

warfighters. Following the SPR, space operators were encouraged to consider the possibilities and consequences of war extending to space. Previously, operations were focused solely on operational discipline and execution within a benign environment, not on the potential dangers and operator responses to an attack on US assets in space. This would be equivalent to naval surface officers ignoring enemy actions, assuming the only threats to their ships were either from system failure or from the environment itself. This simple, yet transformative concept highlighted the US space enterprise's antiquated and, arguably, naïve worldview, and ushered in a much needed change.

In 2015, the DoD announced the creation of the JICSpOC. It was intended to act as the first operational construct of the DoD's Third Offset Strategy; Secretary of Defense Chuck Hagel's initiative to gain the competitive advantage following the erosion of America's dominance in key warfighting domains in the 21st century.[10] The operations center was co-located with the Air Force's 50th Space Wing, which provides command and control for many of the space constellations, including GPS and military communications satellites, in order to "facilitate information sharing across the national security space enterprise."[11] This co-location accelerated the cultural transformation of the traditional space operations crews to an appreciation of the threats inherent in space warfare and their responsibilities throughout the spectrum of conflict.

[10] Department of Defense, *The Defense Innovation Initiative*, November 15, 2014, accessed February 2, 2018, http://archive.defense.gov/pubs/OSD013411-14.pdf.

[11] Courtney Albon, "JICSpOC to Achieve Initial Operations this Year," *InsideDefense.com*, September 20, 2016, accessed January 1, 2018, https://search.proquest.com.nduezproxy.idm.oclc.org/docview/1821707971?accountid=12686.

More specifically, the JICSpOC consolidates all efforts associated with national defense of space into a single C2 center.[12] The JICSpOC's mission is to develop and improve the US's ability to rapidly detect, warn, characterize, attribute, and defend against threats to space systems.[13] The JICSpOC also helps to identify capabilities that threaten US space systems as well as identifying tactics, techniques, and procedures in order to provide accurate and reliable indications and warnings in the domain. Rear Admiral Brian Brown, deputy commander of U.S. Strategic Command's Joint Functional Component Command for Space, said the JICSpOC is meant to improve data sharing between the intelligence and military communities as well as help protect and defend space assets.[14] This includes maneuvering satellites to avoid collisions, modifying the operational limits of satellite sensors to avoid electromagnetic damage, and other passive actions. Brown summarized the new space paradigm: "In any domain, you have to understand what you need to do to defend an asset; you have to have good situational awareness, and then you have to be able to discern the attribution and intent of any activity in that domain."[15]

The JICSpOC ran numerous experiments in 2015 and 2016 to challenge the assumptions and readiness of the US space enterprise and has become a learning organization. Major General Clinton Crosier, director of plans and policy for U.S. Strategic Command said, "every time the JICSpOC runs an experiment, it looks at

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[12] Department of Defense, *New Joint Interagency Combined Space Operations Center to be Established*, U.S. Strategic Command, accessed January 2, 2018, https://www.defense.gov/News/News-Releases/News-Release-View/Article/616969/new-joint-interagency-combined-space-operations-center-to-be-established/.
[13] Albon, JICPpOC to achieve…, 2016.
[14] Courtney Albon, "JICSpOC Highlighting Need for Real-time Space Situational Awareness," *Inside the Pentagon's Inside Missile Defense*, October 26, 2016, accessed January 2, 2018, http://seaerch.proquest.com/nduezproxy.idm.oclc.org/docview/1832163201?accountid=12686.
[15] Albon, JICSpOC to achieve..., 2016.

potential threats that adversaries may be developing and pits them against U.S. systems in order to identify better ways of protecting those assets. It also considers the speed at which decisions and maneuvers need to be made, what authorities are needed to take protective measures and what new capabilities might enable operators to make real-time decisions in a contested environment."[16]

In early 2017, the JICSpOC was renamed the National Space Defense Center in an effort to clarify its role and to distinguish it from Joint Space Operations Center (JSpOC). The JSpOC continues to focus on operational employment of worldwide joint space forces, the integration of space power into global operations, as well as satellite catalog maintenance. The division of labor between the two operations centers results in net efficiencies and ensures proper attention is given to both space threats and theater engagements.

In 2015, General John Hyten, commander of Air Force Space Command initiated the Space Mission Force (SMF). This effort symbolizes the high water mark in the first chapter of the burgeoning new US space posture. His vision was to build a command with Airmen that acknowledged and prepared for a space environment that had evolved into a contested, degraded, and operationally limited environment where adversaries had developed and fielded capabilities to disrupt and deny US space systems.[17] This initiative was a product of the previous strategic studies on the US space culture that highlighted a need for change. SMF was designed to transform the space warfighter culture through advanced training. The objective was to build a cadre that will be an

[16] Albon, JICSpOC Highlighting Need…, 2016.
[17] Hyten, *Space Mission Force*…2016.

active force in dynamic times and to ensure US space superiority in the future – the ability to conduct operations and deliver effects at the time, manner, and method of choice, while denying that capability to the enemy.[18] Whereas space operators of the past were skilled at responding to environmental risks, system failures, and manmade errors, SMF reprioritized to responding to a thinking adversary ahead of system and status monitoring. The environment, while still difficult and demanding, remained neither the primary, nor the only threat. The term "operator" was exchanged for "warfighter" to signify and accept the fact that space is a warfighting domain and Airmen were challenged to find innovative ways to use old and reliable technology.[19] The resulting tactics, techniques, and procedures fed into the cultural transformation and resulted in Airmen challenging the norm and learning the intricacies of their space and ground-based systems. The result is a more capable and nimble military force, building upon the historic strategic deterrent, while also becoming better prepared for a decisive and deliberate response, if required. It is clear AFPSC has reaped the short-term advantages of SMF implementation. The long-term achievements will depend on both domestic and international actions. The mindset in DoD is that the US must maintain the momentum in space, in parallel with its conventional teammates. If not, it will cede the initiative and supremacy of the space domain to potentially hostile competitors.

Ironically, the overwhelming strength of US air, land, and sea conventional forces, which the US relies on as a deterrent against foreign attack on it space systems is, in fact, the primary driver for competitors to pursue assets in space. Just as game and

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[18] Ibid.

[19] Raj Agrawal, "Space As a Warfighting Domain," Peterson Air Force Base, accessed Feburary 5, 2018, http://www.peterson.af.mil/News/Commentaries/Display/Article/1300653/?space-as-a-warfighting-domain=(.

market theory suggests, opponents will act where the environment is weakest and the opportunity is greatest. The 2001 Space Commission echoed this warning. "As history has shown," its report observed, "if the US offers an inviting target, it may well pay the price of attack."[20] Paradoxically, the US dominance and reliance in space has also uncovered its susceptibility. Some suggest the only way to maintain this advantage is by taking aggressive action through the development and fielding of overwhelming means, including on-orbit weapons.

The US must be measured in its philosophy and strategy. The past has clear lessons of the folly of rash decisions involving the massive escalation of combat firepower in a domain. Britain built the Dreadnought in the early 20th century to counter growing threats in order to assure peace and global stability. Ultimately, it sparked a dangerous evolution of naval power and set ablaze the armament race with Germany.[21] The US must move cautiously to avoid a similar mistake.

Yet the increased threat in space to US interests is undeniable and requires strategic leaders and planners to continuously reevaluate the environment.[22] While policy and strategic rhetoric have remained largely consistent in recognizing the risk in space, the military strategy has lagged behind. The study of the history and evolution of the space domain clearly indicates the increasing potential of some form of attack (including non space-based attacks, such as against ground-based satellite command and

[20] U.S. Congress. Commission to Access US National Security Space Management and Organization. *Report of the Commission to Assess United States National Security Space Management and Organization*. (Washington, D.C.: U.S. Government Printing Office), 22.
[21] Giles Edwards, "How the Dreadnought Sparked the 20th Century's First Arms Race," BBC News, accessed December 28, 2017, http://www.bbc.com/news/magazine-27641717.
[22] U.S. Joint Chief of Staff, *Joint Planning*, Joint Publication 5-0 (Washington DC: Joint Chiefs of Staff, June 16, 2017), 14.

control sites and temporary or reversible electromagnetic attacks). The consequence of an attack on US space systems has also grown significantly. During the 1960s and 1970s space enabled effects were small and redundant with other capabilities. Today, DoD is heavily dependent on space-enabled effects to prosecute the American way of war; one that relies on speed, maneuver, flexibility, surprise, and minimum collateral damage.[23] What would have led to a marginal effect in the past could have a significant or even critical consequence in a modern high-end conflict. This slow migration of mission risk has been largely neglected because military risk is often directly linked and calculated based on the probability of causalities or risk to force. Mission risk is measured through a function of probability and consequence.[24] The failure to measure adequately the risk to mission if the US lost its space systems is reckless and could put US on Sun Tzu's death ground if not properly calculated.[25] Operational level commanders and planners must avoid the temptations of assuming away the potentially catastrophic risk posed by the loss of US space systems.

The efforts of the past 20 years yield a better understanding of the modern strategic space environment and provide a background to the initial shift in US space posture. Although appropriate and measured, taken out of context or studied in a vacuum, one could misinterpret their stabilizing intentions and question their peaceful goals. These actions could unintentionally motivate competitors to field on-orbit weapons. In order to alleviate the fears of others and design a space posture for the modern space domain, the US must continue to evolve its space strategy to optimize its

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[23] Max Boot, "The New American Way of War," *Foreign Affairs* 82, no. 4 (Jul-Aug 2003), 42.
[24] U.S. Joint Chiefs of Staff, *Joint Planning*, Joint Publication 5-0 (Washington DC: Joint Chiefs of Staff, June 16, 2017), V-14.
[25] Sun Tzu, *The Art of War*, trans. by Samuel B. Griffith (London, UK: Oxford University Press), 131.

deterrence effects, lead an international effort to bolster the continued world-wide peaceful use of space for military support, and review its organizational structure in order to optimize its efficiency and clarify its joint purpose. Lastly, the US must complete a space-based capability review to ensure the on-orbit systems support the policy and strategy that enable stability in the domain.

CHAPTER 5: *STRATEGIC INITIATIVES NECESSARY FOR US SPACE ASSET SURVIVAL*

"*The difficulty of a task is no reason to avoid it.*" President George W. Bush

The burgeoning threats in the contemporary military space domain reveal a need to secure the vital constellations of satellites that are essential to both the peaceful and military pursuits of the United States (US). While today's US political and military leaders deserve credit for recognizing the critical importance space-enabled effects provide to the US security and prosperity, the work is far from complete. The current US space posture, a broad vision between the Secretary of Defense and the Director of National Intelligence that outlines the future of US space acquisition, system integration, and technology development, highlights critical dependencies as well as unacceptable vulnerabilities.[1] While this essential action is in progress, strategic necessity demands additional efforts. Today's security environment and competitive space domain requires that the US must maintain its dominant position in space in the coming decades. To accomplish this, the US requires both policy and organizational changes to support a long-term space strategy. The new posture and strategy, together with the strength of the US conventional and nuclear forces, will strengthen the US space deterrent and combat potential. The timing of these actions is critical. Russia and China's recent pursuit and launch of inherently offensive space capabilities (under the guise of technological experiments) must be addressed with a new strategy. The recommendations below focus on long-term actions that will ensure the space domain remains a neutral, accessible, and stable domain for all countries.

[1] Department of Defense, "Space Posture Review Key Points & Facts," *defense.gov,* accessed February 1, 2018, https://www.defense.gov/News/Special-Reports/SPR/.

A Comprehensive Space Strategy of Deterrence

Since the opening of the space domain, the US has led the world in the pursuit of non-weaponized development of space capabilities. Through the decades, it created a benign, yet militarized environment that provides an asymmetric advantage to the modern US military. Its space systems provided unprecedented supporting effects such as navigation, communication, intelligence, and missile warning. These evolved into force multipliers for US combat capacity and became integral for US contemporary warfighting. Open sources report significant counter-space technical development is underway in both Russia and China. This has created a strategic crossroads for US policy and strategists.

Strategy is founded on policy, and therefore recommendations must begin with policy. In the 21st century, US space policy has ranged from short-term periods of focused attention followed by long periods focused on maintenance of the constellation. The 2001 Space Commission remains the most comprehensive review of space strategy, but a decade and a half of war has made it largely outdated. In the last decade, Congress has directed changes and displayed its disappointment in the senior management and oversight of space.

In 2017, during the drafting of the Fiscal Year (FY)18 National Defense Authorization Act (NDAA), the House Armed Services Committee expressed serious frustration in the Department of Defense's (DoD) stewardship and development of space capabilities (both in equipment and manpower) and passed an amendment to the NDAA that would create a separate Space Corps. While the idea did not remain in the final

version of the act, Congress was sending a clear message: space required greater attention, and US space assets needed greater security.

Due to its unique role as both service provider and joint force enabler, no single service has oversight responsibility for the space domain. To address this potential gap, the Secretary of the Air Force was named the Executive Agent (EA) for Space in 2003.[2] This invested additional authority and responsibility in the position and was designed to improve joint acquisition and create cross-service space-related synergies. In 2017, the EA for Space responsibility was revamped and renamed the Principal DoD Space Advisor,[3] but it was not included in the FY18 NDAA. However, the document did add a requirement that the commander of Air Force Space Command serve for 6 years to ensure continuity and adequate oversight over the lengthy space acquisition process and provide a single Air Force leader responsible to the Secretary of Defense for balancing the various service space requirements, as well as executing space missions. These policy initiatives represent efforts to optimize joint space operations, yet there remain organizational disconnects to investigate and resolve.

US national policy has roots in multinational law and is one of the lead architects of the modern international order. The current international agreements for space are antiquated, vague, and open to extreme interpretation. The US must lead a new round of international space agreements that promote the peaceful use of space, limit attempts to arm space platforms, require signatories to agree to specific anti-satellite provisions, and establish international bodies that can regulate actions and hold violators accountable.

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[2] Department of Defense, *DOD Directive 5101.2: DoD Executive Agent for Space*, Incorporating Change 1, June 22, 2003 (Washington DC: Department of Defense, 3 June 2003), 1.
[3] Department of Defense, *DOD Directive 5100.96, June 9, 2017* (Washington DC: Department of Defense, 9 June 2017), 1.

Non-state organizations and commercial entities would be subject to state signatory approval. Additionally, a comprehensive international space-focused agreement clarifying the norms related to the integration of dual-use (commercial and academic) space faring enterprises is needed. These endeavors would reduce ambiguity, ease unsubstantiated fears, establish new norms (for state and commercial actors), and institute a foundation from which to negotiate during peacetime and communicate during conflict to mitigate unintended consequences, while opening the opportunity to law-based solutions.

While the conditions in the global domain mature and the US military continues to implement cultural and organizational changes while pursuing international solutions, the US objective in space remains the same: maintain a stable, peaceful, accessible global commons for all nations. This end state necessitates the formulation of a 21st century coherent space strategy that best prepares the US in case of a conflict in space against a near peer competitor. This strategy will support deterrence and has the potential to prevent a conflict.

The principle of constraining an opponent's behavior without violence is a tempting, yet often difficult goal to achieve. Since the end of World War II, deterrence has remained a cornerstone of US foreign policy, as the perceived benefits were valued far beyond the costs of global nuclear war. Given the long-term devastating effects that would come from attacks on space systems, the new US space strategy must not only continue to embrace deterrence, it must elevate and strengthen its influence.

Deterrence is an incredibly complicated strategic art. Every action, or inaction, is perceived by an opposing decision maker, and therefore affects the efficacy of the

deterrent. Therefore, every new initiative incorporated into the new space strategy must focus on having a direct and positive influence on the deterrent efforts of the US space posture. The remainder of this section will highlight the critical aspects of commitment, capability, and credibility necessary to maximize the deterrent influence.

Improved commitment concerning space deterrence is grounded in consistent and unwavering public and private communications regarding the vital importance of US space assets. The President, Congress, and Secretary of Defense must continue to reiterate the strategic implications of an attack. Potential adversaries must understand the US perceives satellites in orbit as national assets and an attack would be interpreted as an attack on a strategically critical target in the homeland and against its sovereignty. The policy must also clearly define how the US interprets a temporary or degrading attack, versus a permanent or destructive attack.

Capability is broken into three sub-components: nuclear and conventional forces, active space defense, and space situational awareness. The US has always relied on its nuclear and conventional forces to deter space aggression, and this will not change. The US dominance in power projection and endurance is the undeniable central element of the military instrument of power. However, competitors are designing potentially dangerous counterspace weapons in the face of this US conventional dominance. In order to augment the conventional capability, the US must research and develop space-based technologies to increase the space capabilities. If this leads to the development of an active self-defense capability, demonstrating the defensive intent of the capability would, in theory, boost its deterring effect, while mitigating escalatory responses.

Developing capabilities in the domain of threat is frequently the best approach, as it is easier for the opponent to recognize and understand decisions made in reaction to a threat. The further the threat response is from the originating action (e.g. ground attack in response to space attack), the higher the risk the opponent may misinterpret the response as a separate or unrelated escalatory act. The optimal deterrent influence is reached by increasing the threat and scope of response, while maximizing the cost of action in all domains.

Lastly, capability depends on understanding the environment. Space situational awareness (SSA) involves accurately tracking and identifying all orbiting objects throughout the lifecycle of the satellite or debris. This is critical, as one must first accurately understand the situation prior to an attack in order to precisely attribute and respond following an attack. The US has the most advanced SSA network in the world, and plans to upgrade the system with a high-resolution space radar fence in 2020.[4] To support its deterrent influence, the US should continue to publicize this capability and invest in the mission area in the future. With these three seams closed, the capability function of space deterrence will remain strong.

The final tenet of deterrence is credibility. Similar to commitment, the linchpin to US credibility lies with communication. Over the decades, the US has stood by allies and has placed its troops in harm's way for a myriad of scenarios even though many of them did not pose a direct threat to the US homeland. This willingness to engage supports the premise that the US does not only use its military might as a last resort. It also uses it as an instrument of justice and protection. Competitors in space must recognize these facts.

[4] Roger Mola, "How Things Work: Space Fence," *Air & Space Magazine*, February 2016, accessed February 1, 2018, https://www.airspacemag.com/space/how-things-work-space-fence-180957776/.

To support this message, the US must use clear and unambiguous language. Idle threats or failed promises will erode the credibility of deterrence. This may be particularly true in space, where there may be no direct human loss associated with an attack. The consistency of message from administration to administration in a democracy is a potential challenge and must be overcome through bi-partisan compromise and long-term commitment. Policy can and will change, but leaders must recognize the drawbacks of those changes and be deliberate and thorough in planning the messages and intent to be conveyed.

Organizational and Institutional Considerations

Manpower is the most critical element to support these missions and is permanently in limited supply. The modern contested space domain demands a review of manpower utilization across the mission areas to redefine what are inherently military activities. In the future, military mission-sets such as satellite command and control may become less dominant in the face of emerging missions such as space defense and growing mission areas such as space control, which includes the tasks of supporting freedom of action in space for friendly forces and defeating adversary efforts that attack or interfere with US space systems; and space situational awareness, the characterization the space capabilities operating within the terrestrial environment and the space domain.[5] These mission sets will require a complete review and restructuring of operational crew size and function.

DoD must also review and update its doctrine to account for the new space strategy. In the January 2017 version of Joint Publication 3-0, space superiority is

[5] U.S. Joint Chiefs of Staff, *Space Operations*, Joint Publication 3-14 (Washington DC: Chairman of the Joint Chiefs, May 29, 2013), x-xi.

described as the degree of dominance in space that permits one force to conduct operations at a given time and place without prohibitive interference, and is highlighted as critical to overall mission success, yet it clearly does not account for a contested, degraded, and/or operationally limited space environment.[6] Joint doctrine needs to develop operational concepts that achieve and maintain space superiority for the joint force commander, and avoid the past's narrow interpretation of space planning.[7] This limited context of space planning in joint doctrine highlights the misalignment between the space domain of the past and the competitive domain it has become. These artifacts of the past could best be eradicated if the US returned to a threat-based planning construct, a philosophy that is centered on potential adversaries and their capabilities, not one that assumes the access and survivability of current capabilities. A rapidly evolving domain such as space demands greater attention and risk acceptance than that witnessed in the current pace of doctrinal revisions.

Since the militarization of space, US senior leaders from the highest levels of government have tended to micromanage space operations, particularly those that would expend fuel and reduce a satellite's lifespan. While logical in a benign environment, in the future senior leaders must minimize restraints where prudent and practical. The USAF principle of centralized command and control and decentralized execution is equally valid in space. Strategic leaders must clearly define objectives, intent, and rules of engagement in line with strategy and policy. This is the essence of mission command.

[6] U.S. Joint Chiefs of Staff, *Joint Operations*, Joint Publication 3-0 (Washington DC: Chairman of the Joint Chiefs, January 17, 2017), 214.
[7] Ibid.

Only then can the force adapt quickly enough to maximize mission assurance, while simultaneously deterring or dissuading the opponent.

Finally, DoD must reevaluate the strategic organizational construct in order to optimize US operations in the modern space domain. The current bifurcation of the organize, train, and equip (OT&E) functions across the military branches is inefficient and counter to the fundamentally joint space systems. While a separate branch is not required, DoD must improve the current structure. Modeling space after the US Special Operations Command may significantly improve the oversight of responsibilities. As US Cyber Command relieves the cyber mission from US Strategic Command, now may be an optimum time to consolidate the OT&E functions and specialized acquisition funding under a single combatant command. This command would be ideally suited to ensure the US space capabilities would be acquired and employed in a joint manner, from cradle to grave.

Space-based capability review

The US must reform the space acquisition process. To maintain its advantage in space, every aspect of the government space architecture must be questioned and critically reviewed. The single most important modifications to future spacecraft design and acquisition, as it related to mission systems, are selecting the appropriate and feasible technology solutions (Technology Readiness Levels - TRL), ensuring rapid and reliable access to space, and the distribution of capabilities across more resilient US and allied satellite constellations.[8]

[8] Department of the Army, "Technology Readiness Levels in the Department of Defense (DoD)," *army.mil*, accessed February 2, 2018, https://www.army.mil/e2/c/downloads/404585.pdf.

The US can no longer invest massive amounts of time and money into single, gigantic, technological masterpieces, as it did in the past. In a completely benign environment, this approach was the most cost efficient and effective. However, to secure the satellite constellations, as is required now, a single satellite of extraordinary capability is too vulnerable. Strategic leaders of the past desired the most advanced technology available and were willing to invest the time and risk to obtain it. In the future, the US must foster speed of acquisition and development of highly capable, but easily attainable technology over the exquisite capability that the highest TRL represents. Single spacecraft dependency would be reduced and risk would be spread across a constellation.

The US has long recognized the importance of rapid and reliable space access and there are encouraging trends. In 2006, the USAF funded Operationally Responsive Space, which focused on rapid fielding of urgent space capabilities to support the warfighter. More recently, commercial space launch companies, such as SpaceX and Blue Origin, are providing new models for rapid launch, recovery, and refitting of launch vehicles. DoD must leverage these best practices and instill their philosophies into internal processes where speed, value, and reliability are required.

While military leaders have implemented fundamental cultural changes to face the new strategic environment and the stand-up of the National Space Defense Center has added great value to the operational level of space warfare, the US has failed to examine fully the potential of an on-orbit satellite defense capability. While in the terrestrial domains the primacy of defense is widely favored over offense, in space the opposite is true. The poor maneuverability of older satellites and the nearly non-existent outer defensive layer provides the advantage to the offense.

The evolution of the military space domain demands that the US research a defensive technology that will minimize the perception of an offensive weapon, while protecting its critical on-orbit capabilities. These active defense measures would form an anti-access/area denial boundary that would ensure localized space superiority in a threatened environment. They could take the form of sentinel satellites positioned near older satellites or self-sufficient spacecraft that ride on future vital systems. Not all satellites would need these capabilities. Those technologies suited for wide distribution and redundancy (large satellite constellations) would mostly likely master resilience through this non-active defense measure.

A responsible active defense system that remains coherent with US policy and objectives would avoid explosive charges, which would litter the orbital regions, and instead focus on surgical kinetic impact or electromagnetic forces to disable or maneuver the opposing spacecraft out of threat range. Inherent in this capability must come delegation of authorities and permissions, in order to maximize survivability and responsiveness. US leadership and action throughout this capability review, while controversial to some, is the best way to mitigate a new security dilemma in space. John F. Kennedy's comments from 1962 resonate again in this new dawn of space militarization, "This is a breathtaking pace, and such a pace cannot help but create new ills, as it dispels old, new ignorance, new problems, and new dangers."[9]

In order to maintain its space dominance and lead the world in a renewed commitment to a peaceful and non-weaponized space domain, the US must continue the momentum of the past twenty years. It must revise a 21st century military space strategy

[9] President John F. Kennedy, *Address at Rice University on the Space Effort*, September 12, 1962.

focused on deterrence, execute a DoD-wide analysis and update to the institutional and organizational structures, and openly review and investigate the most appropriate space-based capabilities. While these recommendations are prudent, we must remember that potential adversaries can affect this strategy. In the past 20 years, their doctrine and technology development have been focused on growing counterspace capabilities. The US response must be in line with its strategic culture: global leadership based on open dialogue and focused on international order, with a demonstrated reserved strength.

CONCLUSION

Space has always, and will continue to inspire humans. And like all environments that include human activity, competition and conflict historically soon follow. This does not make war in space inevitable, but it must make the goal of preventing one a priority. Understanding the potential aftermath of warfare in space illustrates the importance of its prevention. General John Hyten, Air Force Space Command commander, observed that "on the ground, rebuilding a bombed area can return it to its previous state of usefulness in a short time. But geosynchronous orbit is the most valuable real estate in space, and debris there can render it useless for centuries."[1] The US objective in space over the past 60 years has remained constant: it denies the benefits of the peaceful use of the domain to no one, but demands responsible use and mutual cooperation.

The evolution of space capabilities through the three phases clearly illuminates the maturation of the space domain, an environment that is uniquely and optimally suited for military, commercial, scientific, and civilian utility. In today's space domain, the world has reached a nexus of economic opportunity, increased technological complexity, and the potential introduction of inherently offensive capabilities. Who leads the future of space will shape the domain for decades. Failure of the initial US vision of the 1960s could lead to kinetic attacks and orbiting debris fields that would deny the domain's benefit to the world. For the benefit of humankind, the US must lead. Just as President Kennedy's words spurred the nation in the dawn of the space age, his words speak true in this age as well, "The United States was not built by those who waited and rested and

[1] John Hyten, "Hyten: Space Command Should be an Active Force in Dynamic Times," *intelsatgeneral.com,* accessed February 15, 2018, https://www.intelsatgeneral.com/blog/hyten-space-command-should-be-an-active-force-in-dynamic-times/.

wished to look behind them," he said, "This country was conquered by those who moved forward—and so will space."[2] America must not yield the initiative; it must forge the path to a peaceful space domain of the new age.

[2] President John F. Kennedy, *Address at Rice University on the Space Effort*, September 12, 1962, accessed October 12, 2017, https://er.jsc.nasa.gov/seh/ricetalk.htm.

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